V

TOOLS FOR FORMULATING ICT COMPONENTS AND PROJECTS IN THE EDUCATION SECTOR

A. Challenges and Approaches in the Use of ICTs in Education

The Policy and Operational Environment

Successful introduction of any technology or any innovative way of doing things better in the education sector depends to a large extent on an enabling policy environment coupled with a well-structured and logical implementing framework. A truly enabling environment incorporates certain important characteristics that are most often a challenge to instill.

Personal commitment of key stakeholders. Elected and appointed senior officials, administrators, and practitioners must be familiar with the advantages, challenges and limitations that are part and parcel of integrating IT into education. It is critical they to take into consideration the cultural and social ramifications of ICT in education, and realize that simply ordering, distributing, and installing computers in schools is a recipe for disaster.

Invest in the human component first. It is absolutely essential to dedicate the necessary time and effort to preparing the groundwork

with local champions—especially teachers and administrators. They must be involved in the process at the very outset to make sure that when the appliances and content arrive, they are received in an environment that is comfortable, knowledgeable, and hospitable, and they are appreciated as instruments to leverage teaching skills—not as objects of a mysterious cult of knowledge practiced only by IT experts. There have been too many unfortunate accounts of major procurements of PCs sitting in warehouses, or lying useless on desks or in spare rooms waiting for repairs, software, or a kindred soul who knows what to do with them. Such experiences have negative results that go far beyond the misuse of scarce resources. Since the prime local movers of ICT in education may be blamed for the failure of the project, such setbacks cause people who would normally be champions in their area of influence to be much more circumspect toward similar future ventures. ICTs' tainted image may extend to officials in other ministries, parents, administrators, etc., and may take years to alter.

Get fully qualified people involved. Another obstacle to success is the selection of poorly qualified experts to support the introduction of ICT in a new environment. In a major Caribbean country, the InterAmerican Development Bank extended a loan for the computerization of schools. The international experts selected to plan and implement the process had stellar academic records, but little in the way of practical applications of ICTs in schools, and no real hands-on experience. Teachers were trained on the benefits of ICT, and on applications that came with the PCs. About a month after the consultants finished their assignment, most of the computers were reported to be non-functional by the teachers, and they quickly reverted to their old ways. An investigation by the PC supplier revealed that, among many problem areas, the teachers simply turned off the power switch of the PCs at the end of their own period of use, and could not "find their programs" when they turned them on again the next day. They had little or no practical knowledge of the PC's utility in a learning environment.

There must be a spirit conducive to change. Officials of the local executing agency, including the policy experts, key administrators, and influential teachers must have a sound appreciation of the process and expected results. They must be personally convinced that the

introduction of ICTs in the learning environment needs to be well supported to ensure that the new technologies will not be used to simply extend or replicate a traditional classroom model, but rather to fundamentally change the instructional paradigm, with ICTs serving as levers for system-wide curricular reform and educational change.

There must be acknowledgement that the management of change is a major component that must be absorbed by the key participants in capacity building. In the great majority of projects that introduce ICTs to an existing organization, it is assumed that management and staff will somehow be dragged along by the flow and this will eventually transform them by osmosis into advocates of the technology. This is seldom true. People develop over the years work habits, procedures, and personal ways of getting desired results in an environment where nothing is really pressing. In an ICT-enabled world, such variables as information that is of poor quality and stale, incompetent management, and a focus on process rather than results for the client quickly become apparent. There must be realization that the human institution and its machinery must be renewed in a structured way. The key individuals involved must be carefully trained on how to bring about significant improvements in their own workplace and to nurture similar improvements among their peers and subordinates.

The Social Environment

ICTs can contribute benefits to such diverse issues as life skills, basic literacy, and technological literacy, even among the poorest. But there are often challenges in the social environment to successful introduction of ICTs.

Lack of homogeneous clusters of client population. Poor people in developing countries often are dispersed, and comprise disparate groups of youths and adult learners. Distance education through ICTs can be an effective tool in this context.

Teachers often are inadequately trained and supported in poor regions. ICT-supplemented teacher training becomes crucial in such regions in order to improve teaching and student learning.

The poor do not easily fit into a structured system. Many of those targeted for educational improvements or expansion are unable to attend traditional classrooms and/or are too old for the formal school system. The interactive and asynchronous nature of ICT can provide useful solutions in this context.

Information has to be conveyed in a manner that can be understood and appreciated. The diversity of poor people in terms of ethnicity, language, gender, etc. requires the kind of social group focus that, when properly employed, is potentially far more effective using ICT than in the traditional classroom. Even teachers that are very capable may lack, for example, the language skills necessary to be effective with poor, minority-language learners.

Knowledge should be available to clients in an environment that is comfortable to them. Some noteworthy national programs include the UK's Online ICT Centres and the Wired up Communities Programme. The latter is piloting home access to ICTs in the most disadvantaged communities. The key finding in planning this initiative was that in order to reach the most marginalized people, ICT-supported learning should take place in comfortable, "home away from home" surroundings. Individuals who had a bad experience in school may not want to take courses in the traditional classroom setting. The most effective approach is to host people to learn about ICTs, and how to use ICTs for their own benefit, in very informal, peer-led environments. Instruction starts with a focus on students' personal interests, leading a guided tour of the Internet.

The Educational System

a. At the Teacher Level

Time availability. There is seldom enough time allocated for both formal training and self-directed exploration, and for using applications to develop content and other resources for classes. This barrier can be addressed by providing the teacher with a good standard foundation course that can be progressively enhanced by experience and self-instruction supported by periodic assessments. Class preparation time can be allocated, as can specialized resources within

the school—such as course authors, multimedia developers, and instructional design experts—to help the teacher migrate his or her materials to an ICT environment. Two models that can be evaluated are that of Hong Kong, where the teacher can be trained to do everything in an autonomous way, or OLA, where support modules and specialized expertise are available through the organization so that the teacher can focus almost exclusively on the empowerment of the learner.

Self-confidence in using ICTs has not been built up enough. This is often the case when computers are acquired without preparing the human element well in advance. Again, this is attributable to a lack of basic training and familiarization for the teacher, who should be the classroom and community champion for the successful introduction of ICTs.

Negative experience with ICTs in the past. This barrier can best be overcome by peer group support. Technologies have evolved to the point that teachers can often become productive with a few hours of familiarization; they can work outward from a successful and user-friendly core application, such as Ten Minute Publisher and others available from Cisco and HP. A community of peers with similar interests and making use of standardized applications becomes a fertile nurturing ground for neophytes or for those whose previous attempts were unsuccessful.

Fear of embarrassment in front of pupils and colleagues, loss of status, and an effective degrading of professional skills. This arises when there is no supporting environment, such as in an isolated school. Possible solutions include individual adjustments to welcome inevitable change, and delegation of some responsibilities to support staff and learners who may be more competent with technology. This would mean that the success of the class depends not on the teacher, but on the teacher's team as a whole.

Classroom management difficulties when using ICTs, especially where pupil-to-computer ratios are poor. This is a frequent barrier even in developed countries. While the teacher supports those who need help the most, the more competent and adventurous are browsing areas that are not related to the class effort, and distract their

peers. This can be solved to everyone's advantage by encouraging the fast learners to guide groups of peers in assignments and learning. This approach, in addition to multiplying the teacher's presence, stimulates competition for success between groups of learners.

Inadequate teacher knowledge to resolve technical problems when they occur. The teacher should not be wasting time and getting frustrated with appliance and software problems. If local technical support is inadequate, then the ICT environment must compensate by offering either networked PCs with server-based applications that are in "deep freeze" or are self-monitoring and healing, or PCs with ROM-based applications where the user cannot modify the applications.

Personal inability to cope with change. This barrier can best be surmounted by organized professional training in change management, preferably in a peer group of teachers with varying degrees of resistance to change.

Perception that technology does not enhance learning. Fortunately, the proponents of this view are dwindling in numbers rapidly. This view remains common in developing countries, however, where there is limited exposure, if any, to ICT-enabled applications. There are a number of possible solutions, including demonstration projects using internationally-proven best practices. A model such as that proposed by ADB's Center for Learning, Information, Communication, and Knowledge (CLICK) would be most beneficial to support large-scale projects involving ICTs in poor countries. Alternatively, stand-alone CDs can provide captivating illustrations of highly effective ICTs that work.[155]

Lack of motivation to change long-standing pedagogical practices. This is a common problem in countries with a socialist history where individual resistance and incompetence is generally tolerated, and performance measurement is not welcome. There is usually stronger focus on process than substance, and the situation is magnified where the tradition of tenure is still strong. Both positive

[155] For an excellent example, see How Things Work at http://howthingswork.virginia.edu/ and How Stuff Works at http://www.howstuffworks.com/.

and negative corrective measures can be brought to bear, and these are well documented in pedagogical literature.

Perception of computers as complicated and difficult to use. There is some justification to this view, especially where there has been little preparatory training of teachers and where they have not been involved in the planning process. This situation is compounded by poor selection of appliances and software. The use of the PC should more enjoyable to use than a book for both teacher and learner. Again, this barrier can be addressed by proper training and exposure to demonstration projects, especially where a hands-on capability is available.

b. At the School Level

Lack of ICT equipment, and the cost of acquiring, using and maintaining ICT resources. This issue is directly related to political commitment, discussed earlier. If there is no policy support, dedicated school administrators are often compelled to approach parents and other sponsors to acquire the required equipment and software. Since this method is not part of a planned, holistic strategy, many gaps arise that are not evident at the outset. PCs will be supplied with basic operating and office applications, but no allowance for software that will help teachers deliver knowledge, nor is there usually technical support to keep the appliances operating smoothly. Even when state-of-the-art PCs are supplied, the total cost of ownership (TCO) has seldom been taken into account. This barrier can only be addressed properly by a strong and knowledgeable political commitment, backed by appropriate resources, and recognition that teachers must teach, not become less-than-efficient maintainers of appliances. Acquisition, software, maintenance, and updating expenditures can be minimized by planning for protected and remotely administered PCs networked to central locations. This is much simpler and economical than the image conveys, and can be accomplished elegantly even under the most difficult conditions by using modern technologies, such as cacheing and remote monitoring and support for technical and content issues.

Poor access to ICT equipment due to organizational factors, such as the deployment of computers in ICT labs rather than in

classrooms. This problem is often due to scarcity of resources, where a school with limited facilities will wish to protect them and make them available under controlled conditions to the largest possible number of users. Time combined with a good track record with users may well result in budgets providing for additional resources. Where poor access is a function of poor planning, there should be a gradual change toward distributed access in the classroom. In cases where the problem persists—such as administrators reserving PCs in their offices as status symbols when they do not know how to use them, donors must clearly lay out the conditions for use, and monitor progress systematically.

Obsolescence of software and hardware. This is a common problem, especially in developing countries. The ideal solution is again through a remote support agreement with the supplier that calls for regular upgrading of equipment and software over say, a 3-year contract. Where this is not possible, older items can be handed down the chain to the primary level where high computing performance is not as critical, since most K to 6 software can sit on fairly basic platforms. In several countries, arrangements with local technical colleges prove of mutual benefit, since the technical learners have access to a steady supply of cases in a real life situation, and the schools can expect quick turnaround and continued support. Education departments in the Asia-Pacific region seldom take advantage of excellent free software, such as Star Office, nor are they generally aware of special considerations that are available through educational licensing agreements with the major suppliers.

Unreliability of equipment. This may have been a problem for equipment purchased prior to 2001, but the technology has improved so much since that it should no longer be an issue. PCs do not require air-conditioned clean environments. The server can hold all software and delicate components, and it can be located in a protected closet. User terminals consisting of monitors, keyboards, and mice, and other devices are very robust and can withstand a very wide range of environmental conditions.

Poor technical and administrative support. This obstacle is an element of the planning process. Technical support is just as critical as up-to-date software, connectivity, and reliable appliances. Political

commitment to ICTs must include adequate budgets for support to prevent teachers from getting bogged down in administrative and technical issues.

Lack of institutional support in leadership and planning, and minimal involvement of teachers and managers in implementing required change. This barrier is very closely linked to the management of change issue discussed above. The introduction of ICTs involves institutional change that requires that everyone move ahead together, and teachers are not left unsupported. There must be a minimum threshold of basic ICT understanding as well as ownership common to all members of an organization before full-scale introduction of ICTs.

Training is not differentiated according to teachers' differing ICT skill levels. A common error is trying to maximize numbers attending a training session, rather than optimizing the number of well-trained and motivated teachers who could, in turn, help their peers. The former approach fosters a climate where some are bored while others are constantly challenged. Differentiation of learners according to their own aptitudes and prior training is essential to making effective progress. A sensible and standard three-level approach like that used in Hong Kong is an excellent methodology.

Teaching in basic skills is not followed by training focusing on integrating technology in the classroom. The learning of basic computer skills by teachers is only a first step in a continuum, and should not be seen as an end in itself. Starting with basic familiarization, a laddered approach, such as that used by Schoolnet India, can support the teacher to promising and much needed career specialization, such as course authoring, content development, and multimedia design. In turn, a strong core capability with a diversified field of expertise will provide much enhanced service to the student population.

B. Applications and Benefits of ICTs in Education

This section includes spin-off effects that impact on poverty reduction and employment prospects.

Teachers and Learners and their Environment

A comprehensive review of research findings on ICTs in education reveals that they are surprisingly unanimous in concluding that ICTs stimulate:

- Less directive and more student-centered teaching.
- Increased emphasis on individualized instruction.
- More time engaged by teachers in actually advising students who require more attention rather than trying to provide a "one size fits all" service.
- Increased interest in teaching as a profession and a practice.
- Broadening of professional sources of knowledge and training and career horizons for teachers.
- Interest in experimenting with emerging technology.
- Teacher preferences for multiple technology utilization.
- Increased administrator and teacher productivity.
- Improved planning and collaboration with colleagues.
- Rethinking and revision of curriculum and instructional strategies.
- Greater participation in school and district restructuring efforts.
- Business partnerships with schools to support technology.
- Increased education involvement with community agencies.
- Enhanced and more frequent teacher and administrator communication with parents.
- Enhanced and more knowledgeable involvement by parents and home tutors in supporting the learner.

Results

The keys to raising student achievement are to provide students with a solid foundation of basic skills and to motivate them to learn. Technology can help accomplish this goal. It engages students and

fires their imaginations. It helps teachers stimulate young minds in ways that make a profound and lasting difference. A number of results have been proven attributable to the introduction of ICTs in education:

- Students were found to score significantly higher in standardized tests.
- Students studying language arts in a multimedia environment gain more auditory, language, decoding-in-context, and story-composition skills than students who do not use computers.
- High school students were found to retain math skills longer after using commercially available mathematics software than did students in a control group receiving traditional classroom instruction.
- A study of elementary-aged students learning math found that students who used multimedia computer software showed less math anxiety and more frequently perceived the subject as relevant to everyday life than students in a control group.
- Another study found that technology improves students' communication skills and the quality of their presentations and makes it easier for them to complete writing and editing assignments.
- Researchers analyzing how technology affects the study of science discovered that adding computerized lab analysis tools and simulations to high school biology curricula led to significantly better content knowledge and science process skills.
- Students who tend to refuse to do class work were found to be more motivated and eager to work since they did not perceive computers as an "authority figure."
- Students especially "at risk" were found to improve their attitude and confidence toward learning.
- Students with learning handicaps significantly improved their problem solving skills.
- The use of telecommunications leads students to improve their writing skills.
- Students showed increased mastery of vocational and work force skills.

- Computer use facilitates student collaboration on projects, and thus enhances the team work abilities that are indispensable in the work place.

Impact in Specific Areas

Numerous research studies on the impact of technology on student achievement have demonstrated these findings with remarkably similar results. A review of the literature resulting from these studies supports the following conclusions:

- Students, especially those with few advantages in life, learn basic skills—reading, writing, and arithmetic—better and faster if they have a chance to practice those skills in a self-regulated, non-intimidating, motivating, and challenging environment using technology.
- Technology engages students on a personal level, and as a result they spend more time on basic learning tasks than students who use a more traditional approach.
- Technology offers educators a way to individualize curriculum and customize it to the needs of individual students so all can achieve their potential.
- Students who have the opportunity to use technology to acquire and organize information show a higher level of comprehension and a greater likelihood of using what they learn later in their lives.
- By giving students access to a broader range of resources and technologies, students can use a variety of communication media to express their ideas more clearly and powerfully.
- Technology can decrease absenteeism, lower dropout rates, and motivate more students to continue on to college.
- Students who regularly use technology take more pride in their work, have greater confidence in their abilities, and develop higher levels of self-esteem.

C. Configuration of Hardware, Software, Policy, and Training for Classroom Operations

From lessons learned over the past ten years, we know that there are a few basic ways that computers can be distributed and configured to meet educational goals; we have also learned what does not work. PCs can be provided to individual classrooms, installed in central computer labs and used by students in rotation, or placed in libraries, with some in teachers' planning rooms. Each of these options, and their combinations, has associated benefits and costs that need to be carefully considered.

Computers in Classrooms

According to a study by the Milken Family Foundation, computers inside classrooms are more effective than centralized computer labs in producing basic skill gains in students and in promoting the confidence and technological competence of teachers. Teachers who had computers in the classroom reported higher skill levels in delivering instruction, planning lessons, managing paperwork, and word processing, and more time using computers for reading, math, and writing instruction than teachers whose access was limited to computer laboratories.

Locating PCs in classrooms has significant benefits. The PCs are closer to the users, and teachers and students may interact better in a classroom environment. But not all schools and classrooms can accommodate computers in sufficient numbers. Providing only one or a few computers in all classrooms of a school will likely have little or no impact on learning since it will be difficult for teachers to make computer use an integral part of their teaching, especially if the ratio drops to less than one computer for each five learners. Theft and vandalism need to be considered when placing PCs in classrooms. Also the maintenance of software is important. Software is easy to steal. Implementers must seriously consider the use of the Deep Freeze[156] or Radix products to ensure daily integrity of the PCs.

[156] Product of Faronics Inc.

Alternative to Computers in Classroom Strategy

Computers On Wheels (COWs), like HP's Rover product, are carts that hold a set of computers (10 to 20), usually laptops, often a printer, with the possibility to connect to a school network via a single network connection. COWs can be wheeled into a classroom when the teacher wants to use computers for a specific activity. COWs can be beneficial because it makes it possible to provide teachers access to computers in their classroom without having to significantly remodel the room, provide special furniture, or reserve space for dedicated computers. Using battery-powered laptops makes it possible to avoid the need to provide special electrical power. COWs allow schools to optimize the use of expensive equipment by enabling any teacher to request a cart of computers. Since software only needs to be purchased for the computers on the carts and not for dozens of computers in each classroom, the cost for software can also be much less with COWs than with conventional classroom computer installations. However, the initial cost of COWs with laptops and wireless networking capabilities is higher per computer than conventional stationary computers. COWs can be seen as "communal" property and therefore it can be more costly to maintain them—especially when using laptops—than with stationary systems. There is also a greater risk of equipment damage from accidents, hard use, or dropping with COWs using laptops than with stationary equipment.

As an example, Hewlett Packard's COW holds and operates as many as 30 laptop computers in a classroom. It is built on wheels, and can be rolled into a classroom ready for use. The big benefit is that the power system allows for all the laptops to be charged at the same time without the school having to change its electrical system. All these laptops are then enabled with cached content provided by the SchoolWeb[157] system. They may be wireless or wired. But the former is recommended.

[157] http://www.advancedinteractive.com/SchoolWeb/CANARIE.html.

Computer Rooms or Labs

Establishing one or more computer rooms or labs is a popular way to provide a more distributed and equitable access to computers for the greatest number of students at the lowest possible cost. Like science labs, the computer labs enable schools to concentrate expensive resources in a common space that can be used for student educational and extramural activities, teacher professional development events, and community groups. When using computer labs, it is important to arrange computers along the walls of the room rather than in rows so that teachers can view all the students' work from a common point and move quickly and easily from student to student, providing feedback and support. It can also make it easier and less costly to provide electricity and network access to the computers.

Among the benefits of having Computer Labs are:

- Quality and clean electricity, network cabling and servers, effective security, good lighting, and furniture can be installed in one or two rooms in a school rather than in many different rooms. With today's technology there is no need to have climate-controlled rooms anymore. The fans installed in PCs today are quite adequate. Equipment and software costs can be less for computer labs used by all classes than by classroom-based systems;
- Computer labs can make it easier to encourage collaborative projects among groups of teachers and students.

However, computer labs can quickly become oversubscribed and competition for their use may make it difficult for teachers to engage their students in longer-term ongoing projects and activities. Furthermore, scheduling conflicts can frustrate teachers and inhibit use of computer labs. Additionally, users, as with COWs, can see computer labs as a communal resource and thus feel a reduced sense of responsibility, thus making maintenance more difficult.

Learning Networks for Schools

Today the majority of schools in Asia do not have learning networks. In fact, many schools do not have enough computers to justify a network. And even if they had them it would not be surprising to find that many of them are not working because "they crashed," and no one was available or qualified to fix them. Schools in Asia cannot afford technical staff. In fact, those that do lose them quickly to industry thanks to better conditions and income.

Despite this situation, schools are progressively getting more PCs and enterprising teachers are using them as a resource in teaching. In more progressive locations such as Singapore, Malaysia, Taipei,China, and Hong Kong, China, it is probable that most schools have a number of PCs used for teaching or for research purposes. Programs such as "Computers For Schools," where the business community donate their older PCs to schools, have helped greatly in PC placement in schools and in preparing students for the digital world.

Nevertheless, teaching using PCs in schools in Asia is a rarity. Why? Many schools do not have know-how or budgets for such forms of teaching because ministries of education have not promoted it because of a lack of vision and skill at the ministerial level. Most educators, however, know the immense benefits of being able to teach a subject using multimedia resources to illustrate a point. Imagine everyone is class being able to see, in color, how a four-stroke combustion engine works by going to a web page put up by How Stuff Works (footnote 163), instead of trying to understand the concept by reading a book with passive illustrations. Lack of bandwidth, however, may not allow this to be done on a classroom basis. If 40 students go to http://Howstuffworks.com at the same time, the server may not be able to handle the simultaneous hits. Even if it were able to, the time taken to deliver the site to 40 PCs in the same classroom in a distant and remote location would be a problem. Fortunately, this bandwidth problem has affordable solutions developed in the Linux platform. Today, it is possible for a school that is equipped with a 56K line to have high-speed delivery of learning content to a classroom.

Canarie's[158] SchoolWeb is a consolidated server technology that enables schools with many computers to access high-speed Internet at a very affordable cost. The developers of this technology, Advanced Interactive, promote the service with the notion "*High-speed Internet for 2.00 per student per month.*".The caveat is that the school must sign up for 5 years, and have at least 1,000 students—although more modest pilot projects can be implemented in developing countries. As part of the agreement, a CampusAxxess, or SchoolWeb firewalled Linux system, will be installed in the school with no license fees attached, 40 PCs, and a network printer. The only recurring cost for the school is a monthly monitoring service charge of $250. Every student will be given an email address and a web page. All schoolwork will be automatically backed up every night. This system is a boon to remote schools. Advanced Interactive has partnered with HP to look after all the servers across the world for 36 months. Additionally, it has partnered with WorldSpace for one-way satellite connectivity that feeds the Internet service. The receiver system from WorldSpace, which is included in the price, is set at very low cost because the company's vision is better education for Africans and Asians.

National Learning Networks

UNESCO recommends that each country establish a national network that networks schools, universities, and colleges to national and international distance education facilities with databases, libraries, research labs, and computing facilities. This is a tall order for many countries, with capital and operating costs appearing prohibitive at first glance. But the results may be well worth it. In fact, throughout Asia countries are taking initiatives to set up national networks. For example, Sri Lanka has this aspiration in its education modernization plan.[159] It sees this kind of network as a tool for peace and an instrument for raising standards of living. The interactive sharing of information between users regardless of race, gender, religion, or color has enormous benefits, which will help realize the potential of human capital.

[158] See www.canarie.ca.

[159] See Sri Lanka Distance Education Modernization Project in Appendix 1.

Indonesia has launched a student computer literacy program aimed at introducing information technology in schools nationwide. Dubbed "One School One Computer Lab," one objective of the program is to establish infrastructure in the form of sufficient hardware for schools and improving telecommunications and Internet infrastructure in a number of regions.

Similarly, India has announced an ambitious $8.2 million plan to set up 139 Community Information Centres connecting villages across Indian-administered Kashmir, to connect the state's 2,681 villages, alongside call centres and other schemes to boost IT.

The Philippine government launched a $22-million Integrated Distance Learning Program in June 2003 which uses satellite, television, computers, the Internet, and solar power to target some 3,000 communities, or barangays, across the Island of Mindanao. The program is designed to address the low quality of education and facilities among indigenous peoples, and to help eradicate the roots of insurgency in the region.

South Korea, according to the BBC, is embarking on a huge project to make its national broadband network even faster. The government and telecommunication companies will spend nearly $2 billion to upgrade Korea's network. When the project ends in 2010, the top speed of South Korea's core broadband infrastructure will be 100Mbps.The network would be linked with the country's wireless networks to create a ubiquitous system that boosts e-health and education initiatives.[160] Developing countries of Asia and the Pacific do not have the economic or technological capability of South Korea. However, many could approach such a vision in small increments by building LANs in schools with classroom networks that are linked to the Internet, as outlined in the previous section.

Other Issues

a. Used Computers

With the cost curve for PCs constantly going down, it is preferable to select new equipment—with lower maintenance, improved power

[160] BBC News, Nov 20, 2003.

economy, and better robustness—over used hardware. However, where a viable local alliance can be established, used hardware may very well be worthwhile to provide access and some familiarization to PCs in schools until budgets are available to upgrade to current models.

The Canadian experience provides a valuable example. The Computers for Schools (CFS)[161] concept was first implemented by Industry Canada in 1993 with the support of the Telephone Pioneers of America—a volunteer organization of current and retired telecommunications employees who do community service across North America. Their "Connecting Canadians Initiative" is a multibillion-dollar effort to boost ICT and related applications. Included programs are Schoolnet, the Community Access Program, and Computers for Schools. To date, the latter program has refurbished and distributed to schools over 300,000 PCs donated by federal and provincial and municipal governments, the private sector, and other institutions. In addition to coordinating computer donors and recipients, CFS oversees more than 55 repair and refurbishing centers throughout Canada, where surplus computers are cleaned, refurbished and prepared for delivery. The workshops are staffed by volunteers, including current and retired telecommunications professionals and students. Of special interest is the number of unemployed youth—sometimes classified as "at risk"—who have joined the program and received valuable training leading to gainful employment.

b. Technical Support

Many projects funded by multilateral institutions and other donors for the acquisition of PCs for education do not seem to adequately address the need for hardware and software maintenance. The only backstopping provided may be a combination of the suppliers' warranty, local or school resources, and the poor teacher. Teachers should be trained in how to do some very basic PC troubleshooting, but nothing more than could be resolved easily in five minutes. Technical support is not the teacher's function.

[161] http://cfs-ope.ic.gc.ca/default.asp?lang=en&id=55.

As presented above, the CFS model could apply when new equipment is purchased, since many problems encountered in the classroom environment at the outset will not be addressed under a supplier's warranty. They are more often than not attributable to misuse, viruses, Trojans, or simple neglect. An interesting study was performed in 2003 for the UK's Becta,[163] which clearly demonstrated that CFS-like arrangements with local high schools were by far the preferred technical support solution.

c. Software and Reliability

Schools require reliable software products. It is difficult enough for them to invest in expensive software, but it is a serious problem if those products do not work properly, waste time, frustrate teachers, and do not benefit students. Microsoft, the leading designer of software, has been training its programmers to write more reliable code, and has invested in software tools that check computer code more thoroughly for errors during product development. It has developed software that culls detailed feedback on problems users are having, and uses the feedback to improve products.

Many schools, however are considering using Linux-based products simply because they are not only more reliable, but less expensive. There is a tremendous wealth of very effective and compatible software available from suppliers who are offering their product free, at very little cost, or as part of philanthropic efforts. The best-known applications are Sun's Office, Corel Office, OpenWebMail (openwebmail.org), and Open Office on the Linux platform (openoffice.org). In addition, the major systems providers such as Cisco, Hewlett Packard, Sun, Microsoft, and several others provide free applications software designed to help teachers and learners. Although some of it has a few advocacy strings attached, it is normally state-of-the-art product. Many of these companies also sponsor special educator training programs.

[162] See http://www.ictadvice.org.uk/performance/graph.php?section=4&id=136.

d. Security

Hacking, virus attacks, and spamming are common problems. The number of reported computer security incidents rose from almost nothing in 1998 to close to 120,000 in 2003.[163] The school zone is what has been called "the nightmare zone." School systems are hacked daily, and there are even hackers among students. The cost of fire walling students from these systems could be prohibitive. One less expensive way is to not allow students access to the network systems. By installing programs like Deep Freeze (footnote 192), the integrity of PCs can be maintained. If there is a compromise, the PC only need be re-booted to be returned to its original state.

D. Easy Access Reference Materials

Applications

a. Place Ware

This is a Microsoft product that enables the teacher to show a slide presentation from one end of the connection via the Internet, and use a voice connection at the same time to explain and discuss the presentation. Any additions, changes, etc done by the presenter can be seen by the viewer(s) on another connection(s). This increases productivity and understanding.

b. Microsoft Office Live Meeting

This is more of a collaborative than a presentation tool. Teacher and learners can hold on-site teaching sessions and counseling sessions. A phone and PC with an Internet connection is all that is required. It can be expensive, however, because of the cost of long distance voice calls.

[163] *The Asian Wall Street Journal*. 2003. Keep Hackers Out. 17 November.

c. Smart Library

Voted as one of the best inventions of 2003 is Amazon.Com Jeff Bezos's new search engine that enables registered users to search text inside about 120,000 books. The user is limited to no more than 20% of each book. The first few pages are free. This is a boon to teachers who may be seeking information on particular subjects.

Resources for Schools

a. WebCT

WebCT is a leading provider of e-learning systems for higher education institutions. Many universities pay great sums of dollars to leverage WebCT to expand the boundaries of teaching and learning. WebCT's e-learning systems are designed to accommodate institutions across the spectrum—whether they have just begun to implement e-learning or are already deploying e-learning enterprise-wide. Webct is able to help customers realize the full value of their e-learning investments while providing a flexible, scalable path for growth by backing up their e-learning systems with world-class customer care.

b. Silicon Chalk

Silicon Chalk is a software product and system that supports collaboration, communication, exercises, note taking, and presentation in face-to-face classes where some or all students have laptops, desktops, or tablet computers. It allows distance students to participate and creates a fully interactive recording of every learning activity for later learning, review, refinement, and asynchronous participation. It facilitates the establishment of a learning community and maintains the connectedness of that community regardless of member location. Silicon Chalk recognizes the variety of activities and contexts over which learning occurs, and presents a unified environment allowing students to move from activity to activity, context to context, and role to role seamlessly.

c. Virtual Classrooms

Virtual classroom systems are making their way into DL. They are an interactive and engaging training tool where the presenter can retain the human element of interaction. However, a robust IT infrastructure is necessary. Anything short of a steady Internet connection produces latencies and disruption. This tool is good, but may also require a heavy investment in licensed software. With virtual classrooms, however, students benefit from live human interaction without the need for expensive travel. Participants can attend class from anywhere in the world via a standard Internet connection. They can work as a group and collaborate on ideas, communicating with both presenters and each other via voice, real-time text, or private one-on-one chat. Participants can also ask questions, make comments, and use a shared "whiteboard" to illustrate a point to the group. Presenters can use anonymous survey tools to check training effectiveness in real-time. Manufacturers claim that low bandwidth Internet connections would be OK, but in practice this is not so. Students also need to have microphones and speakers; consequently, the PCs must also have sound cards.

d. e-Portfolio

An e-Portfolio is not merely a file of course projects and assignments, nor is it a scrapbook of teaching memorabilia. It is an organized, goal-driven documentation of a student's growth and achieved competence during the complex act of learning. Portfolios are part of a performance assessment process designed to enable a student to demonstrate their abilities to meet course and program objectives and standards. Such assessments require students to synthesize the knowledge, skills, and dispositions acquired in a course; reflect the real-life work of the teaching profession; revise their written work; make choices that reflect their interests, abilities, and needs; and reflect on the value of the experience in regards to professional growth and development. E-Learning experts are promoting such a tool.

It is advocated in teacher education programs, instilling the norm of reflective practice as well as introducing the requisite knowledge and skills to approach teaching in a reflective way. E-Portfolios provide an opportunity and structure for student teachers to document and

describe their teaching; articulate their professional knowledge; and reflect on what, how, and why they teach.

e. Education Management Information Systems

There is a tendency to develop an EMIS as though it has never been done before, with resulting high expense, waste of time, and user frustration. Starting with a standard platform, which can range from a simple MS Access application to a complex integrated and modular relational database such as Oracle, there are literally dozens of highly competitive software packages available either off the shelf, through specialized vendors, or from counterpart institutions in the developed world.

Internet-Based Resources

The Internet offers a wealth of rich, compelling and up-to-date multimedia content for practically any course, from kindergarten to grade 12, through tertiary, and including skills development and professional training. Much of this material is available for localization with no conditions—except in some cases, a simple intellectual property agreement. Consequently, a country that aims to develop its own proprietary material from scratch will incur substantial non-recoverable expenses and a significant lag in bringing its offerings to market. This is the unfortunate tendency of some core groups with only a basic knowledge of materials development. Whether the basic subjects be in reading, mathematics, science, or humanities, the matter to be learned is similar across nations. There will be a need for much more localization in the case of such topics as history, economics, and geography, but they should be adapted from existing material and not created from scratch if at all possible.

a. Commonwealth of Learning (COL)

COL (www.col.org) has a mandate to stimulate and foster the development and sharing of open learning/distance education knowledge, resources, and technologies for learners throughout the British Commonwealth. Responding to needs expressed by the Commonwealth's 54 member governments, it engages in both in

country and regional project work, as well as fee-for-service consulting for international agencies and national governments.

b. Asia-Pacific Development Information Programme

The APDIP (www.apdip.net) is an initiative of the United Nations Development Programme (UNDP) that aims to promote the development and application of new ICT for poverty alleviation and sustainable human development in the Asia-Pacific region. It does so through three core program areas, namely: policy development and dialogue; access; and content development and knowledge management. APDIP attains its objectives through activities that involve awareness raising and advocacy, building capacities, promoting ICT policies and dialogue, promoting equitable access to tools and technologies, knowledge sharing, and networking. Strategic public-private sector partnerships and opportunities for technical cooperation among developing countries are the key building blocks in implementing each program activity.

c. Cisco Networking Academy

Launched in 1997, the Cisco Networking Academy Program[164] has evolved from a high school network support curriculum to a worldwide educational program to advance the Internet economy. Partners in the Academy Connection and Ecosystem expand the curriculum as well as the technology and techniques in order to deliver it through continuous improvement. The Academy Connection is the virtual home of the Cisco Networking Academy Program. The program prepares tomorrow's IT workforce, helps bridge the digital divide, and allows one to experience true e-learning technology. The Academy Connection also provides access for members to the Academy community where they can effectively manage academies, classes, and users, and deliver curriculum and exams.

In Ecosystem, Cisco has partnered with leading organizations to form a global ecosystem to support e-learning. Major business partners and top companies create, deliver, and promote e-learning solutions to educational institutions worldwide through the Academy

[164] See http://cisco.netacad.net/public/index.html.

program. The Internet and education are the two great equalizers of our time. When combined into e-learning, they eliminate barriers of time, distance, and socioeconomic status, creating potential for change in people and places around the world. Cisco aims at speeding this change through e-learning.

The Internet economy has transformed both the delivery and the requirements of education in the 21st century for all ages. On the Education Issues site, information about top concerns and issues—such as education reform and education technology—is gathered and summaries, briefs, and sample Academy solutions are provided to help an organization navigate new territory.

The Global Learning Network is a network-enhanced e-learning infrastructure designed to support the Cisco Networking Academy Program. It gives students worldwide a rich, interactive environment with proficiency reporting and personalized feedback that responds to multiple learning styles.

d. Computers 4 Kids

Computers for Kids (www.c4k.org/) is a program based in Hawaii, US, that provides recycled computers to schools in Hawaii and the region. Helping Hands Hawaii makes arrangements for the distribution of these computers to schools. In this way Computers 4 Kids helps students of all ages acquire the technology and technology skills they need to succeed by providing equitable access to technology resources in homes, schools, and communities. Over 50,000 children, mostly in minority groups with socioeconomic status at and below the poverty line, have been helped. The focus is to empower children in these environments with the knowledge needed for their successful introduction into the work force. Computers can be made available to Pacific island countries and territories. There are similar programs in other states (California) and in other countries to provide recycled computers.

e. International Education and Resource Network (iEARN)

iEARN (www.iearn.org/)is a non-profit global network that enables young people to use the Internet and other new technologies to engage in collaborative educational projects that both enhance learning and make a difference in the world.

f. International Telecommunications Union (ITU)

The International Telecommunications Union's Bureau for Telecommunications Development (BTD— www.itu.int/ITU-D/) has well-established programs to facilitate connectivity and access, foster policy, regulatory, and network readiness, expand human capacity through training, formulate financing strategies, and e-enable enterprises in developing countries. The ITU's BTD services encompass e-strategies, financing, human capacity building, integrating LDCs, policy and regulation, rural development and universal access, technologies, infrastructure, and applications.

g. Pacific Center for Advanced Training and Technology (PCATT)

The PCATT (www.hcc.hawaii.edu) is based at Honolulu Community College and includes a consortium of Community Colleges in HawaiI, US, dedicated to developing and providing training in advanced technology applications in Hawaii and Pacific Rim countries. Honolulu Community College also is the center in the region for the Cisco Networking Academy Program, and has working links with a number of Academies in the region.

h. Pacific Islands Development Program (PIDP)

PIDP (pidp.ewc.hawaii.edu) is a program of the East-West Center at the University of Hawaii, US, that conducts research and training activities in the Pacific island countries. It serves as the Secretariat for the Pacific Islands Conference of Leaders. Research priorities give some emphasis to the role of culture and tradition in development as well as to expanding trade and investment in the region. The PIDP website is a major source of up-to-date information on the countries of the region.

i. Pacific Islands Network (PIN)

PIN (www.unahawaii.org) is a program of the United Nations Association of the US, Hawaii Division, to promote links between pre-university schools in Hawaii and Pacific island countries via the Internet. The program has been in operation for more than a year and a number of links have been established. As the program evolves it is

hoped to establish a regional group or mechanism that will coordinate and monitor the links, and to expand the program to also cover links related to public health.

j. Pacific Islands Telecommunications Association (PITA)

PITA (www.pita.org.fj) links more than 20 of the small island states for the purpose of improving, promoting, enhancing, facilitating and providing telecommunications services in the Pacific Basin. It has an office in Fiji Islands and meets at least twice annually. Some members of PITA are actively supporting the use of the Internet in schools—-Telecom Vanuatu, for example, provides free connection and free online time to participating schools.

k. Pacific Resources for Education and Learning (PREL)

PREL (www.prel.org/) is an independent, non-profit corporation funded by the US Department of Education that serves schools across the US and its affiliated territories from Rhode Island to Palau. PREL seeks to bridge the gap between research, theory, and practice in education, and works collaboratively with schools and school systems to provide services that range from curriculum development to assessment and evaluation.

l. Pacific Telecommunications Council (PTC)

PTC (www.ptc.org/) is an international, nongovernment, non-profit regional organization embracing members from all countries that play a role in the development of Pacific telecommunications. Its over 900 members represent industry, academics, and government and are dedicated to promoting understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere–North, Central, and South America; East, South, and Southeast Asia; Australia; New Zealand; Melanesia; Micronesia; and Polynesia. The PTC organizes a major international conference each year in Honolulu, Hawaii, US, which features a strong focus on education technology.

m. PEACE CORPS

PEACE CORPS (www.peacecorps.gov) has an active program with volunteers in the Pacific islands and elsewhere. Although all are not working on Internet related projects, most of the volunteers are very familiar with the Internet and are in a position to assist schools in their project areas to install and become familiar with computers and the Internet, and participate in training programs in the region.

n. PanPacific Education and Communication Experiment by Satellite (PEACESAT)

PEACESAT (www.peacesat.hawaii.edu) is a public service satellite telecommunications network linking the Pacific Islands. Administered by the Telecommunication Information Policy Group of the Social Science Research Institute of the University of Hawaii (UH), PEACESAT conducts surveys and research on telecommunications policy in the region and organizes related training. One goal is to improve the quality and access to telecommunications at affordable costs, with some emphasis on health and education. PEACESAT has access to the GOES-7 satellite and has satellite stations in most countries of the region, although all are not fully operational. There are T-1 connections between the PEACESAT Network Operations Center at UH and Guam and the Commonwealth of the Northern Marianas Islands. Technical staff visits the countries of the region on a regular basis and monitor the situation in each country.

PEACESAT has telecommunication connections to American Samoa, to which the main schools and research institutions are connected. From American Samoa there is a direct cable link to Samoa and the National University of Samoa, with a connection to the main hospital in Apia. Services provided are voice and video conferencing, electronic mail, and access to the Internet and the World Wide Web.

o. Rotary International

Rotary International has chapters throughout the world, including chapters in Hawaii, Samoa and Fiji Islands, all of which carry out projects to support development. For example, Rotary chapters in Hawaii and Samoa are active in providing computers to schools, and can provide useful services on a number of levels.

p. asakawa Pacific Island Nations Fund (SPINF)

SPINF (www.spf.org.jp) is a special fund of the Sasakawa Peace Foundation that has sponsored a number of telecommunications-related projects in the Pacific Islands region. These include sponsoring a series of newsletters on "Lessening the Gap of the Digital Divide in the Pacific Islands," and support for programs organized by PEACESAT.

q. Secretariat of the Pacific Community (SPC)

SPC (www.spc.int) is located in Noumea, New Caledonia, and was formerly the South Pacific Commission, which was founded in 1947. All 22 of the Pacific Island countries and territories are full members of the SPC. Its work program provides technical advice, training, and research services designed to develop the technical, professional, scientific, research, planning, and management capabilities of the Pacific Island peoples. SPC has an Information Technology and Communication Unit.

r. Schools Online

Schools Online (w.schoolsonline.org/) is a public benefit organization with the mission to help students gain access and use the communication and information resources of the Internet for learning and cross-cultural dialogue. It does this by providing appropriate technology and Internet access, developing locally-driven and sustainable Internet Learning Centers, facilitating teacher professional development, cultivating online cross-cultural projects, and sharing its knowledge and experience. Since 1996, over 5,700 under-served schools in the US and over 400 schools in 35 other countries have received the equipment and support necessary to get online.

Schools Online assesses the state of connectivity in a local environment and works with the country's telecom providers and local businesses to provide affordable lease-lines, ISDN, and wireless technologies, where possible. Students work together on collaborative projects over the Internet to solve problems affecting their lives. Teachers are trained to take steps beyond their traditional experiences in education to identify, use, and share their most effective practices to maximize Internet use.

s. United Nations Development Programme (UNDP)

UNDP (www.undp.org) is the UN's global development network. It advocates for change and connects countries to knowledge, experience, and resources to help people build a better life. It has offices in 166 countries, working with them on their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and its wide range of partners.

World leaders have pledged to achieve the MDGs, including the overarching goal of cutting poverty in half by 2015. UNDP's network links and coordinates global and national efforts to reach these Goals. Its focus is helping countries build and share solutions to the challenges of democratic governance, poverty reduction, crisis prevention and recovery, energy and the environment, information and communications technology, and HIV/AIDS. UNDP helps developing countries attract and use aid effectively. In all its activities, the protection of human rights and the empowerment of women are promoted.

t. United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO (www.unesco.org) has an office in Samoa that links and serves the Pacific Islands in its areas of competence. The staff includes a regional adviser on communications. UNESCO sponsors the Pacific Youth Forum, which brings together youth from the 14 countries to work in areas of common interest. Consideration is being given to develop Internet links with Forum members as a preliminary step in linking schools in the region. UNESCO operates the Associated Schools program linking schools throughout the world. This has a growing Internet component.

u. United Nations Information and Communication Task Force

United Nations Information and Communication Task Force is a special body established by the Secretary-General to help Member States integrate ICT into their development plans and to serve as a catalyst in bridging the Digital Divide. Pekka Tarjanne, the Secretary-General's special adviser on ICT, attended the PTC Conference in

Honolulu in January 2002 and actively participated in discussions on the applications of ICT in the region.

v. University of the South Pacific (USP)

USP (www.usp.ac.fj) has its main campus in Suva, Fiji Islands, with branches in Samoa and Vanuatu and University Centers in each of its 12 member countries. It offers undergraduate and postgraduate degree programs in the major fields of interest in the region. It is a Center of Excellence for all aspects of life in the Pacific Basin countries, with emphasis on the social and cultural needs and interests of the region. It has an extensive Distance Education program and about half of the students use the satellite communications network, USPNet. USP is in a position to play an important role in development of ICT potential in the region.

w. World Bank

The World Bank has a number of ICT-related programs, including World Links for Development (www.worldbank.org/worldlinks),that links more than 1200 schools in 40 countries. The International Finance Corporation has established the Global Information and Communication Technology Group and, in cooperation with Softbank Corp of Japan, has a program to spawn start-up Internet companies in some 100 developing countries. The Information for Development (www.infodev.org) program supports a wide range of programs, including a Conference Fellowship Fund that supports meetings on information and communication technology for development, and Regional Gateway Planning Grants to assist regional groups to develop related programs and activities.

x. World LInks

World Links (www.world-links.org/english/) is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning. The core "value-added" of World Links is its training program, designed to help teachers and students learn to use information and communication technologies (particularly the Internet) to improve teaching and learning. World Links is currently

active in many developing countries, including Cambodia, PRC, India, Indonesia, Lao PDR, Philippines, Sri Lanka, and Viet Nam.

y. Japan International Cooperation System (JICS)

JICS (www.jics.or.jp/jics_html-e/profile/index.html) was founded in 1989 as a non-profit foundation authorized by Japan's Ministry of Foreign Affairs. It specializes in procurement in connection with Japan's Grant Aid (including Technical Cooperation). Its activities include:studies and procurement management services for grant aid; procurement of equipment and supply of information on equipment of technical cooperation; follow-up for grant aid and technical cooperation; enlightenment and support which promote international cooperation; and support for NGO activities.

z. The Global Development Learning Network (GDLN)

GDLN (www.gdln.org/index.html) is a worldwide partnership of DL centers (GDLN Centers) and other public, private, and nongovernment organizations committed to development learning and development dialogue for lasting poverty reduction. Offering a unique combination of DL technologies and methods, GDLN facilitates timely and cost-effective knowledge sharing, consultation, coordination, and training. Through GDLN, individuals, groups, and organizations design and deliver courses, seminars, and other activities that cover the full range of development issues. GDLN Centers around the world have facilities for videoconferencing, Web-based learning, and face-to-face interaction, and also offer logistical support and facilitation services. These provide cost-effective, fast, and high-impact alternatives to traditional meetings and courses, enabling people around the world to connect with each other without having to travel. Activities do not need to be delivered in a restricted period of time because people can continue working even as they participate in events. This gives them time and flexibility to read background materials, prepare assignments related to their actual work, and interact with local peers for an enhanced learning experience.

E-Learning Conferences Worldwide

E-learning Conferences Worldwide (w.conferencealerts.com/elearning.htm) provides a list of upcoming events in internet-based education, educational technology, and related fields.